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April 28, 2025

Mr. Jordan Kannianen
Deputy Executive Director
North Dakota Industrial Commission
State Capitol – 14th Floor
600 East Boulevard Avenue, Department 405
Bismarck, ND 58505-0840

Dear Mr. Kannianen:

Subject: Quarterly Progress Report Entitled "iPIPE: intelligent Pipeline Integrity Program"
Contract No. G-046-88; UND Project – Fund 43500-UND0022445
EERC Funds 23121 and 24817

Attached is the quarterly progress report for the subject project for the period of January 1, 2025 – March 31, 2025.

If you have any questions, please contact me by phone at (701) 777-5402 or by email at amcrae@undeerc.org.

Sincerely,

DocuSigned by:
Austin McRae
2CF0ADBF88C44D7...
T. Austin McRae
Oilfield Operations Specialist

TAM/rlo

Attachment

c: Brent Brannan, North Dakota Industrial Commission
Erin Stieg, North Dakota Industrial Commission

iPIPE – INTELLIGENT PIPELINE INTEGRITY PROGRAM

Quarterly Progress Report

(for the period of January 1, 2025 – March 31, 2025)

Prepared for:

Jordan Kannianen

North Dakota Industrial Commission
600 East Boulevard Avenue, Department 405
State Capitol, 14th Floor
Bismarck, ND 58505-0840

Contract No. G-046-88

Prepared by:

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April 2025

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EXECUTIVE SUMMARY

The following is a quarterly report for activity conducted by the intelligent Pipeline Integrity Program (iPIPE), led by the Energy & Environmental Research Center, for the North Dakota Industrial Commission's Oil and Gas Research Program. The goal of iPIPE is to advance technologies that reduce the frequency and duration of pipeline releases.

Technical activity in Quarter (Q) 1 2025 focused on one remaining project: dedicated space-based hyperspectral imaging.

Orbital Sidekick (OSK) is a company that provides unmatched resolution for hyperspectral imaging from space to identify right-of-way threats and hydrocarbons including methane. OSK vertically integrates satellite technology to better serve commercial clients.

iPIPE supported OSK in the first launch of its Aurora satellite via SpaceX rideshare in 2021. The learnings from the Aurora program were applied to the development and launch of a full satellite constellation. OSK's GHOSt—Global Hyperspectral Observation Satellite—constellation launched and commissioned the first three satellites in 2023. The fourth and fifth GHOSt satellites were launched on March 4, 2024, with more robust design elements based on the prior work. The number of satellites required for the full constellation will be based on the performance of the first five.

OSK established broad functionality of the satellites in the first half of 2024, which includes capturing, downlinking, and processing hyperspectral imagery and resolving bottlenecks. The work during Q3 concentrated on determining technical limits and pushing efficiencies. OSK worked with external partners to conduct controlled-release experiments designed to establish a methane detection limit. OSK also completed the first of ten data captures at the end of Q3. Further efficiencies were achieved in Q4, which include aligning satellite-pointing techniques to eliminate ground swath overlap and pointing and tasking to directly follow pipeline routes. OSK completed the second data capture and is presently working to complete the third. Leak detection and quantification refinement are also continuing.

The OSK subcontract was extended to the end of 2025 to accommodate up to ten data captures over an area of interest (AOI) defined by iPIPE. OSK is working toward the third data capture, which includes Bakken and Permian AOIs. Although OSK has made significant strides to improve the data capture rate over the past quarters, it is likely OSK will not achieve the remaining captures by the end of this year. A project extension into 2026 is anticipated.

iPIPE – INTELLIGENT PIPELINE INTEGRITY PROGRAM
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BACKGROUND

During a May 2017 meeting with North Dakota pipeline operators, then Governor Doug Burgum challenged industry to apply advanced technologies to eliminate pipeline leaks in North Dakota. In response to the governor's challenge, industry chose a proactive path and engaged in a 3½-year program, led by the Energy & Environmental Research Center (EERC), to advance the development and application of emerging technologies to prevent and detect pipeline leaks. The intelligent Pipeline Integrity Program (iPIPE) assists in the development of multiple emerging technologies to prevent and detect pipeline leaks by engaging technology providers to refine not-yet-commercial products specifically for pipelines in North Dakota and demonstrate technology. This goal is supported by accomplishment of the following objectives:

- Select the most promising emerging (near-commercial) technologies for demonstration.
- Assist technology providers in refining their products.
- Demonstrate multiple technologies on pipelines.
- Document results of technology demonstrations.
- Facilitate the adoption of technologies into North Dakota pipeline operations.

Multiple demonstrations of emerging technologies on working pipelines will simultaneously assist technology providers in refining designs, pave a path toward full commercialization in the North Dakota market, prepare pipeline operators to adopt the new tools, and improve pipeline integrity.

Members of the industry-led consortium that provided funding for iPIPE 1.0 include DCP Midstream, Enbridge, Energy Transfer Partners, Equinor, Goodnight Midstream, Hess Corporation, Marathon Petroleum Logistics (MPLx), Oasis Midstream, ONEOK, South Bow, TC Energy, and Whiting Petroleum.

The following quarterly report summarizes the program activities from January 1, 2025, through March 31, 2025.

ACCOMPLISHMENTS DURING REPORTING PERIOD

- Program-level activities
  - Program management
    - Routine activity includes financial and subcontract management.
  - Program meetings
    - On January 16, February 20, and March 20, 2025, iPIPE held monthly member meetings to update all members on program status.

  - On March 20, 2025, the EERC and Orbital Sidekick (OSK) attended the Technology Working Group meeting in Watford City, North Dakota, to share OSK's technology development and iPIPE work with various Bakken operators.

- Technology selection
  - The EERC continues to engage with companies from around the globe that offer emerging technologies. Additional technology providers were sought through iPIPE 3.0.

- Demonstration execution – OSK
  - OSK continued to develop and refine the data capture and spectral analysis capabilities of the five GHOSt—Global Hyperspectral Observation Satellite—satellites in orbit. This included optimizing swath widths and data capture tasking prioritization. OSK implemented a more efficient methodology to capture data over large areas, which included line scanning over longer linear segments and improved satellite-tasking prioritization.
  - OSK has completed the second data capture in accordance with the subcontract. iPIPE is monitoring improved data collection speed as the project progresses.
  - OSK reported several detections over the iPIPE area of interest. The detections were attributed to well pads or compressor stations. OSK has provided methane detections in the range of 300–550 kg/hr and continues to work toward a detection limit of 100 kg/hr.
  - OSK and iPIPE continued to meet biweekly throughout the quarter to discuss progress and upcoming events.

- Demonstration execution – Satelytics Phase IV
  - Satelytics completed its analysis of land movement detection using a current stereo pair of images and stereo pairs-generated historical data.
  - The independent EERC evaluation report for this task has been drafted and is under internal review.

- Demonstration execution – Pipeline-Risk
  - Pipeline-Risk delivered its final report, completed constructing a risk-learning system for gathering lines, and demonstrated its abilities using member-provided data.
  - The independent EERC evaluation report is being drafted.

- Demonstration execution – TOKU
  - TOKU has completed its demonstration of pipeline-monitoring equipment, analysis of leak simulation data, and refinement of algorithms and has submitted its final report.
  - The independent EERC evaluation report for this task has been drafted and is under internal review.

PROJECT AND FINANCIAL INFORMATION

Table 1 presents the budget and expenses incurred by the program to date. The total program value is $9,404,075. The awarded North Dakota Industrial Commission (NDIC) Oil and Gas Research Program funding is $2,600,000.

Table 1. iPIPE Project Costs as of March 31, 2025

		Budget	Expenses	Remaining Balance
NDIC Share – Cash		$2,600,000	$2,514,373	$85,627
Industry Share – Cash		$2,577,000	$2,431,712	$145,288
		$5,177,000	**$4,946,085**	**$230,915**
In-Kind Contributions:	**Members**			
	DCP		$60,500	
	Enbridge		$126,436	
	Equinor		$153,230	
	Goodnight		$37,135	
	Hess		$228,093	
	MPLx		$17,936	
	Oasis		$40,069	
	ONEOK		$5,000	
	Whiting		$9,042	
	TC Energy		$0	
	Energy Transfer		$0	
			$677,441	
In-Kind Contributions:	**Technology Providers**			
	Satelytics		$1,713,450	
	Direct-C		$185,867	
	Ingu		$88,266	
	OSK		$1,321,061	
	TOKU		$190,990	
	Pipeline Risk		$50,000	
			$3,549,634	
NDIC Contribution	**Industry-Cash**		**In-Kind**	**Total Match Funding**
$2,600,000	$2,577,000		$4,227,075	**$6,804,075**
Total Project				
$9,404,075				

The remaining expenses include the OSK subcontract at $230,915, of which $85,627 includes NDIC funds.

A project schedule is provided in Figure 1.

FUTURE ACTIVITIES

The planned activities for the next quarter are detailed below:

- Program-level activities

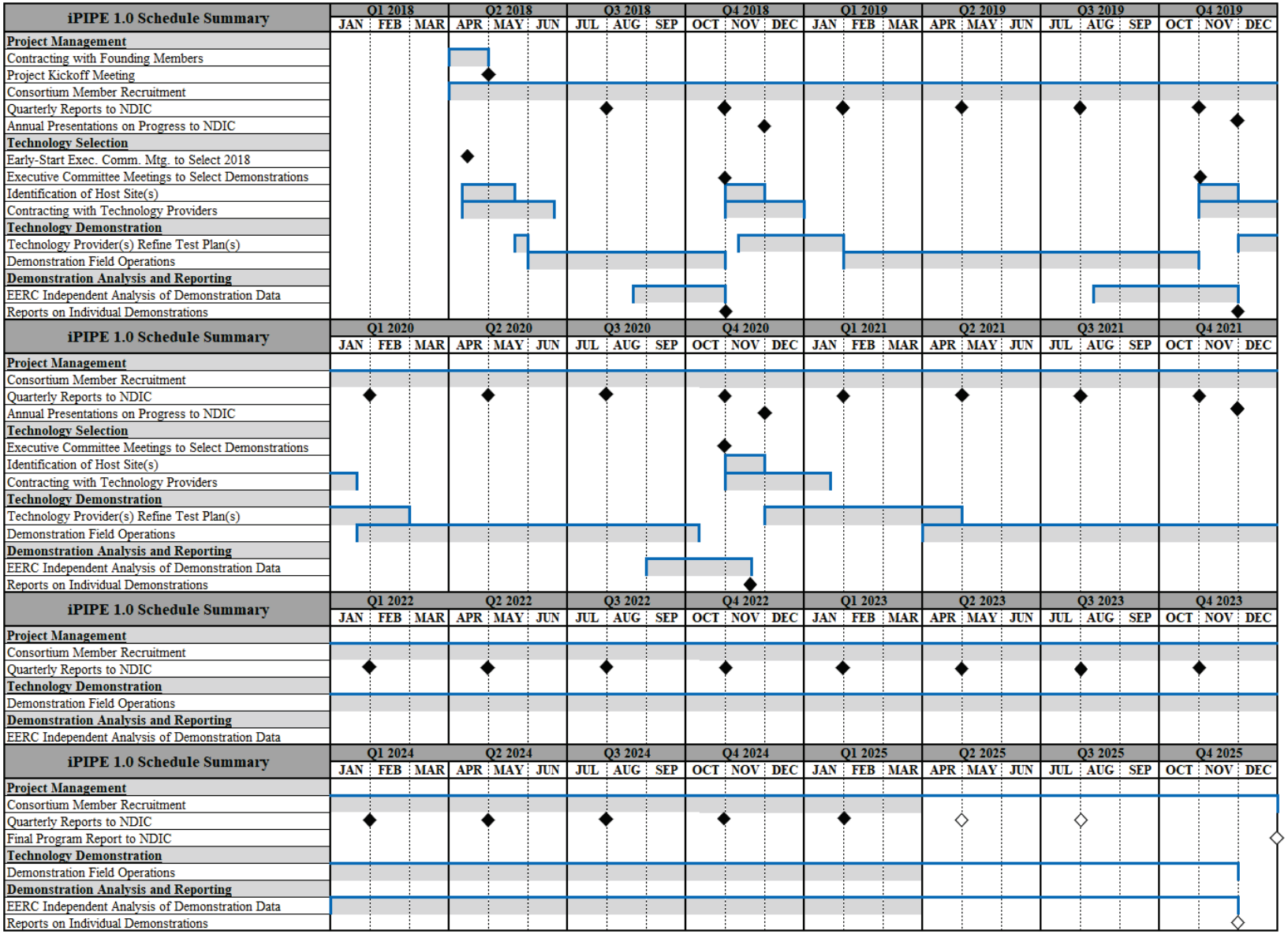

Figure 1. Project progress.

  - The EERC will work with consortium members and stakeholders to continue iPIPE on its successful path beyond the original timeline with iPIPE 3.0.
  - iPIPE will continue ongoing discussions while starting new ones with potential program members.
  - The EERC is likely to submit a project extension later in 2025 to allow completion of the OSK subcontract and all ten data captures.

- Technology selection
  - The EERC will remain engaged with and on the lookout for providers of relevant, promising, emerging technology as iPIPE continues.

- Demonstration execution – OSK
  - The rate of data capture is expected to continue to increase. iPIPE will continue to monitor progress and assist where possible.
  - GHOSt 6 launch is still on the horizon, but no launch window has been provided. The additional satellite will ideally increase data capture frequency.

- Demonstration execution – Satelytics Phase IV
  - The EERC will complete and distribute its independent review of this project. This will complete the project.

- Demonstration execution – Pipeline-Risk
  - The EERC will complete and distribute its independent review of this project. This will complete the project.

- Demonstration execution – TOKU
  - The EERC will complete and distribute its independent review of this project. This will complete the project.